

REMARKS

In the last Office Action, the Examiner rejected claims 1-2 as being unpatentable over applicant's prior art disclosure in Figs. 9-11 ("APD") in view of U.S. Patent No. 6,050,665 to Kishi. Claims 3-5 were rejected under 35 U.S.C. §103(a) as being unpatentable over APD in view of Kishi and further in view of U.S. Patent No. 6,431,672 to Ardito et al. ("Ardito").

In accordance with this response, the specification has been suitably revised to correct informalities, provide antecedent basis for the claim language, and bring it into better conformance with U.S. practice. Original independent claim 1 has been amended to further patentably distinguish from the prior art of record. Original claims 2-5 have also been amended in formal respects to improve the wording and to bring them into better conformance with U.S. practice. New claims 6-20 have been added to provide a fuller scope of coverage. A new abstract which more clearly reflects the invention to which the amended and new claims are directed has been substituted for the original abstract.

Applicant requests reconsideration of his application in light of the following discussion.

Brief Summary of the Invention

The present invention is directed to an ink jet recording apparatus.

Figs. 9-11 show a conventional ink jet recording apparatus. As described in the specification (pgs. 1-5), in the conventional ink jet recording apparatus an operation for managing and setting a voltage rank for each ink jet head is complicated and time consuming because it must be performed manually for each ink jet head. For example, when attaching the ink jet head to the ink jet recording apparatus, setting is performed manually while an operator checks the voltage rank written on a label attached to the ink jet head. The required manual operation also results in substantial instances of setting errors which degrades the printing operation of the ink jet recording apparatus.

Another drawback of the conventional ink jet recording apparatus is that it is difficult to promptly determine the cause of a malfunction or deterioration of the ink jet head. In this regard, it has been difficult for a user to judge whether the malfunction or deterioration is due to failure of the ink jet head or the expiration of its lifetime.

The present invention overcomes the drawbacks of the conventional art. Figs. 1-8 show an embodiment of an ink jet recording apparatus 10 according to the present invention embodied in the claims. The ink jet recording apparatus 10 has an ink jet head 20 comprised of a piezoelectric ceramic plate 30 having at least a pair of partition walls 34 with

deformable side walls spaced apart at a preselected distance to form a channel 33 for receiving ink and communicating with a nozzle opening 32, and a pair of electrodes each connected to respective ones of the side walls of the partition walls 34. A wiring substrate 50 is mounted with a driving circuit 52 including a driving integrated circuit for applying a driving voltage to the pair of electrodes to deform the side walls of the partition walls 34 of the piezoelectric ceramic plate 30 to vary the volume of the channel 33 to thereby eject ink from the nozzle opening 32.

According to the present invention, the ink jet head 20 includes data storage means 100 for storing two or more different types of driving information data of the ink jet head including driving condition data. An external circuit 110 is connected to the driving circuit 52 of the ink jet head 20 and has setting means 140 for reading at least the driving condition data stored in the data storage means 100 and automatically setting driving conditions of the ink jet head 20 in accordance with the driving condition data.

In one embodiment, the driving condition data stored in the data storage means 100 includes voltage rank data for setting to a predetermined value a magnitude of the driving voltage applied by the driving integrated circuit, and dot count data obtained by counting the number of times of ink discharge of the ink jet head 20.

By the foregoing construction of the ink jet recording apparatus according to the present invention, an operation for managing and setting driving conditions of the ink jet head is simplified as compared to the conventional art. For example, in the invention the setting means automatically sets the driving conditions (e.g., voltage rank) of the ink jet head. Thus, a time consuming setting operation of a voltage rank, for example, through manual input is not required during shipment or exchange of the ink jet head. Furthermore, setting errors due to manual input of information are eliminated.

Moreover, by storing dot count data of the ink jet head in the data storage means, the usage status of the ink jet head can be readily obtained to determine whether a deterioration in the ink discharge characteristic is due to failure or expiration of the lifetime of the ink jet head.

Traversal of Prior Art Rejections

Claims 1-2 were rejected under 35 U.S.C. §103(a) as being unpatentable over APD in view of Kishi. Applicant respectfully traverses this rejection and submits that the combined teachings of APD and Kishi do not disclose or suggest the subject matter recited in amended independent claim 1 and dependent claim 2.

Amended independent claim 1 is directed to an ink jet recording apparatus and requires an ink jet head comprised of a piezoelectric ceramic plate having at least a pair of partition walls with deformable side walls spaced apart at a preselected distance to form a channel for receiving ink and communicating with a nozzle opening, a pair of electrodes each connected to respective ones of the side walls of the partition walls, a wiring substrate mounted with a driving circuit including a driving integrated circuit for applying a driving voltage to the pair of electrodes to deform the side walls of the partition walls of the piezoelectric ceramic plate to vary the volume of the channel to thereby eject ink from the nozzle opening, and data storage means for storing two or more different types of driving information data of the ink jet head including driving condition data. Amended claim 1 further requires an external circuit connected to the driving circuit of the ink jet head and having setting means for reading at least the driving condition data stored in the data storage means and automatically setting driving conditions of the ink jet head in accordance with the driving condition data. No corresponding structural and functional combination is disclosed or suggested by the prior art of record.

APD discloses an ink jet recording apparatus as described in the specification and reiterated herein. As recognized by the Examiner, APD does not disclose or suggest

an ink jet head having data storage means for storing two or more different types of driving information data of the ink jet head including driving condition data, and an external circuit connected to the driving circuit of the ink jet head and having setting means for reading at least the driving condition data stored in the data storage means and automatically setting driving conditions of the ink jet head in accordance with the driving condition data, as recited in amended independent claim 1.

The secondary reference to Kishi discloses a printer including a system for automatically adjusting the drive voltage of a print head according to a predetermined rank characteristic of the print head. The rank characteristic is stored in a delay circuit connected to a driver IC 26 of a print head 2 (Fig. 6).

Thus in Kishi the delay circuit functions as data storage means for storing a driving condition (i.e., rank characteristic) of the print head. However, the delay circuit of Kishi does not constitute data storage means for storing two or more different types of driving information data of the ink jet head, as recited in amended independent claim 1. Stated otherwise, the delay circuit in Kishi stores only one type of driving information data (i.e., rank characteristic).

Moreover, unless the "data storage means" disclosed by Kishi performs the identical function specified in amended independent claim 1, it cannot be an equivalent for the

purposes of Section 112, 6th paragraph. Pennwalt Corp. v. Durand-Wayland, Inc., 4 USPQ2d 1737 (Fed. Cir. 1987). In this regard, there is no teaching or suggestion in Kishi of "data storage means for storing two or more different types of driving information data of the ink jet head", as recited in amended independent claim 1.

Accordingly, the combination of features required by amended independent claim 1 are not taught or suggested by the combined teachings of APD and Kishi and, therefore, one ordinarily skilled in the art would not have been led to modify the Kishi in view of APD to attain the claimed subject matter. See, inter alia, In re Fine, 5 USPQ2d 1596, 1598, (Fed. Cir. 1988), and Uniroyal, Inc. v. Rudkin-Wiley Corp., 5 USPQ2d 1434, 1439 (Fed. Cir. 1988), cert. denied.

Claim 2 depends on and contains all of the limitations of amended independent claim 1 and, therefore, distinguishes from the references at least in the same manner as claim 1.

In view of the foregoing, applicant respectfully requests that the rejection of claims 1-2 under 35 U.S.C. §103(a) as being unpatentable over APD in view of Kishi be withdrawn.

Claims 3-5 were rejected under 35 U.S.C. §103(a) as being unpatentable over APD in view of Kishi and further in view of Ardito. Applicant respectfully traverses this

rejection and submits that the combined teachings of APD, Kishi and Ardito do not disclose or suggest the subject matter recited in amended dependent claims 3-5.

APD in view of Kishi does not disclose or suggest the subject matter recited in amended independent claim 1 as set forth above for the rejection of independent claim 1 under 35 U.S.C. §103(a). Claims 3-5 depend on and contain all of the limitations of amended independent claim 1 and, therefore, distinguish from the references at least in the same manner as claim 1.

Moreover, there are separate grounds for patentability of amended dependent claims 3-5.

Claim 3 includes the additional limitation that the driving information data stored in the data storage means includes dot count data obtained by counting the number of times of ink discharge of the ink jet head. Claim 4 includes the additional limitation that the ink jet recording apparatus further comprises data writing means for storing the number of times of ink discharge of the ink jet head as the dot count data in the data storage means. Claim 5 includes the additional limitation that the ink jet recording apparatus further comprises data managing means for managing the dot count data stored in the data storage means.

Thus each of amended dependent claims 3-5 requires dot count data as driving information data stored in the data storage means of the print head. The Examiner cited the

reference to Ardito for its disclosure of an ink jet printer capable of counting ink drops that are fired by a print head. However, Ardito does not disclose or suggest an ink jet head having data storage means for storing a plurality of types of driving information data including dot count data, as required by amended independent claim 1. Since Ardito does not disclose or suggest these structural and functional features, it does not cure the deficiencies of APD as modified by Kishi. Accordingly, one of ordinary skill in the art would not have been led to modify the references to attain the claimed subject matter.

In view of the foregoing, applicant respectfully requests that the rejection of claims 3-5 under 35 U.S.C. §103(a) as being unpatentable over APD in view of Kishi and further in view of Ardito be withdrawn.

Applicant respectfully submits that newly added claims 6-20 also patentably distinguish from the prior art of record.

Each of new independent claims 6 and 13 is directed to an ink jet recording apparatus and requires an ink jet head having data storage means for storing a plurality of different types of driving information data including driving condition data of the ink jet head, and an external circuit connected to the driving circuit of the ink jet head and having setting means for reading at least the driving condition data stored

in the data storage means and automatically setting driving conditions of the ink jet head in accordance with the driving condition data. No corresponding structural and functional combination is disclosed or suggested by the prior art of record.

New claims 7-12 and 14-20 depend on and contain all of the limitations of independent claims 6 and 13, respectively, and, therefore, distinguish from the prior art of record at least in the same manner as claims 1 and 13.

In view of the foregoing amendments and discussions, the application is now believed to be in allowable form. Accordingly, favorable reconsideration and passage of the application to issue are most respectfully requested.

Respectfully submitted,

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